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# Comparative investigation of electrochemical cholinesterase biosensors for pesticide determination

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**Abstract**

A number of potentiometric biosensors based on cholinesterases from various sources have been developed and examined for the determination of Co-Ral and Trichlorfon to establish factors affecting the analytical performance of biosensors. Acetylcholinesterase (AChE) from electric eel and butyrylcholinesterase (BChE) from horse serum were immobilised on the surface of antimony electrode and on the commercial membranes (nylon and cellulose nitrate) by treatment with glutaraldehyde in vapours and aqueous solution. The biosensors developed make it possible to determine Trichlorfon and Co-Ral with detection limits 0.01 and 0.02 mg $l^{-1}$, respectively.

As shown, inert peptide or the polymer present in the membrane provide better sensitivity and lower detection limits of pesticides due to the hampering of the transfer of the product of enzymatic reaction between the membrane and the solution. The influence of the immobilisation procedure depends on the hydrophobicity of pesticide to be determined. The present comparative study reveals the importance of the enzyme matrix on the analytical performance of biosensors developed for inhibitor determination. 

*Keywords:* Biosensor; Cholinesterase; Inhibition; Pesticide determination

## 1. Introduction

Organic phosphates and phosphonates are widely used in agriculture as insecticides due to their high activity, low bioaccumulation and moderately rapid degradation in the environment. Nevertheless, a certain amount of pesticides used is transferred in the surface runoff and subsurface drainage from agriculture land and can cause a spectrum of toxic effects on aquatic organisms and human beings. Trace amounts of organophosphorus pesticides were determined in the surface runoff in daily model experiments 19 days after simulated rainfall was applied [1].

In living beings, organophosphorus pesticides bind irreversibly to the active site of the acetylcholinesterase (AChE) enzyme. This prevents the hydrolysis of acetylcholine and the transmission of nerve impulses. Some pesticides are able to bind to post-synapsis receptors and exert cholinergic or agonist effects [2]. Acute poisoning on exposure to insecticides is common, especially among agricultural workers. The annual world number of deaths for this reason was estimated to be 200,000 in the eighties [3]. Several organophosphates produce the syndrome

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